Intelligent, Autonomous, Distributed Vehicle and Electrical Power System Management, Phase I

Completed Technology Project (2018 - 2019)

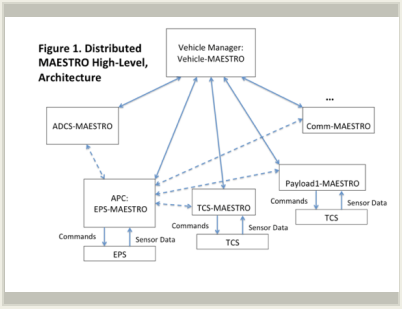
Project Introduction

The proposed innovation, a distributed architecture for intelligent characterization, fault detection/diagnosis/ reconfiguration/replanning/rescheduling, and adaptive execution, substantially leverages large previous NASA investments to assemble the correct set of technologies to implement all aspects of the required intelligent, autonomous vehicle and distributed EPS and other subsystem managers. Stottler Henke has significant experience in all of the required technologies and has already integrated them, under NASA funding, into a general MAESTRO (Management through intelligent, AdaptivE, autonomouS, faulT identification and diagnosis, Reconfiguration/replanning/rescheduling Optimization) architecture designed to be easily applied to spacecraft subsystem management problems. We have applied MAESTRO in a current Phase I effort to Electrical Power System (EPS) management and interfaced it with a laboratory instantiation of a cubesat. Our Research Institution partner, Montana State University (MSU), has designed, built, launched, and operated several satellites with over 14 satellite-years of in-space operations experience. **For this Phase I effort**, in addition to providing substantial knowledge, expertise and practical experience, MSU will also **provide real satellite telemetry data and supplement the existing laboratory hardware testbed (LabSat), with additional boards for more complex subsystems and the ability to cause real hardware faults, both confined within a single subsystem and faults in one subsystem that cause issues in others. This new, augmented LabSat will be used for testing our distributed prototype with real hardware failures**. y also plan to **field an actual proof of concept prototype onboard one of their future satellites, in-space, at the culmination of a Phase II effort**. This work also leverages and extends NASA's Glenn Research Center's Vehicle Autonomous Power Control (APC) Architecture.

Anticipated Benefits

A large number of future manned and unmanned spacecraft would benefit from autonomous, intelligent vehicle and distributed subsystem management. Because it is an open system that other developers can use to create intelligent spacecraft management systems, a large number of MAESTRO applications can be quickly developed. Since MAESTRO is specifically designed to easily interface with Diagnosis, Adaptive Execution, Planning, and Scheduling engines, such developers will have their choice.

Non-NASA spacecraft and Electric Aircraft. MSU plans to field **MAESTRO in space onboard an MSU satellite in Phase II.** Stottler Henke already sells Aurora and associated customization services to private companies with sales over $12 million. MAESTRO improvements can be readily incorporated into Aurora and sold through existing sales channels, especially to the power generation industry which we are already pursuing and oil refineries, power



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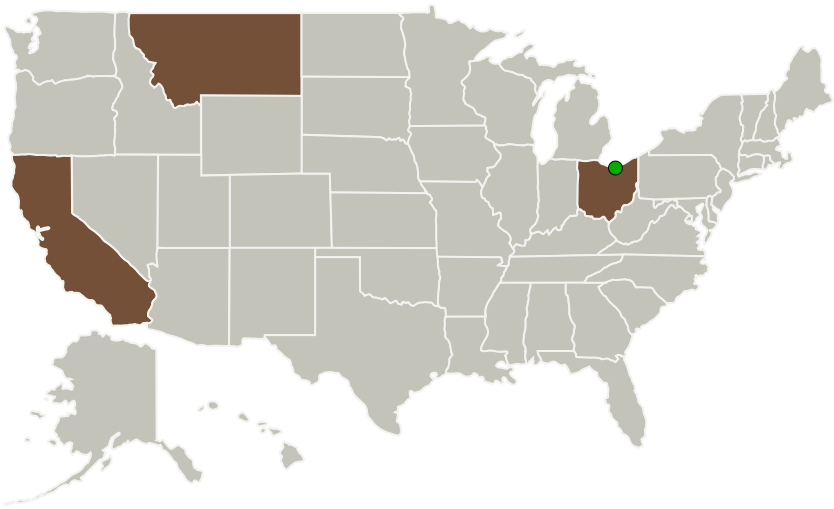
plants, factories of all types, etc.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Stottler Henke Associates, Inc.	Lead Organization	Industry	San Mateo, California
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
Montana State University - Bozeman	Supporting Organization	Academia	Bozeman, Montana

Primary U.S. Work Locations	
California	Montana
Ohio	

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Stottler Henke Associates, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

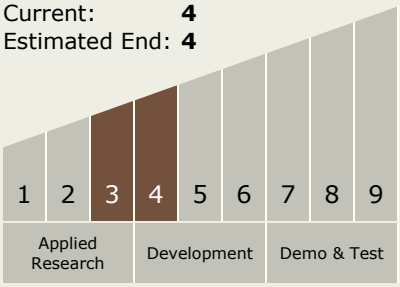
Carlos Torrez

Principal Investigator:

Richard R Stottler

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Project Transitions

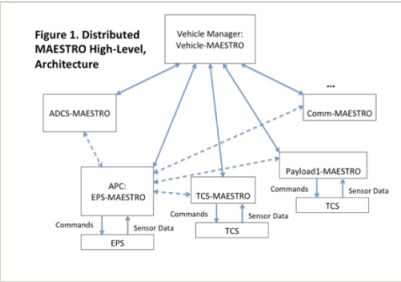
July 2018: Project Start

August 2019: Closed out

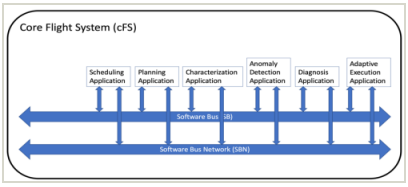
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137845)*

Images



Briefing Chart Image
Intelligent, Autonomous, Distributed Vehicle and Electrical Power System Management, Phase I
(https://techport.nasa.gov/image/130112)



Final Summary Chart Image
Intelligent, Autonomous, Distributed Vehicle and Electrical Power System Management, Phase I
(https://techport.nasa.gov/image/130638)

Technology Areas

Primary:

- TX03 Aerospace Power and Energy Storage
  - TX03.3 Power Management and Distribution
    - TX03.3.1 Management and Control

Target Destination

Earth